About Course 00405639:

Introduction to Topology in Condensed Matter

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Welcome to Course 00405639 – Introduction to Topology in Condensed Matter! For your information, this note includes the syllabus, grading scheme, student guide, contact info, and remarks about reading materials of this course. Please read it asap, and if you have any question, please don't hesitate to ask me by email. Considering the current situation about the coronavirus, our first few classes (hopefully) should be in the form of self-study using the video, lecture notes, etc. by the students, which can be downloaded from *course.pku.edu.cn*. No online instruction/class will be provided. Don't forget that we would have homework assignments. We can have discussion via email or phone call by appointment. Hope you enjoy it!

A. Syllabus. The syllabus includes most parts of the following:

Ch1

1. The basics

1.1 Classical motion of electrons in electrical and magnetic fields

1.1.1 The Drude model

1.1.2 Resistivity and conductivity

1.1.3 The classical Hall effect for low magnetic fields

1.1.4 The classical Hall effect for high magnetic fields

1.2 The integer quantum Hall effect

1.2.1 Landau levels

1.2.2 Quantization

1.2.3 Landau gauge

1.2.4 Symmetric gauge

1.2.5 Degeneracy

1.2.6 Turning on an electric field

1.2.7 How does Landau quantization look like?

5.5 Majorana bound states on vortices

5.6 How to detect Majoranas

5.6.1 Andreev reflection off a Majorana zero mode

5.6.2 Majorana resonance

5.6.3 Conductance signature

5.6.4 *Flux-induced fermion parity switch in topological superconductors

Ch6

Non-Abelian statistics

6.1 Majorana zero modes in nanowire networks

6.2 Non-Abelian statistics of Majoranas

6.3 Manipulation of Majorana bound states

6.3.1 Non-Abelian Berry phase

6.3.2 Braiding Majorana zero modes

6.3.3 Braiding Majorana chiral modes

B. Grading scheme. This scheme is temporary when considering the coronavirus around our country.

- Homework

  6 problem sets to be assigned every two weeks; 50%). They will be assigned after the class and can be downloaded from course.pku.edu.cn.

  The students should hand in the electronic version of the homework answers to the instructor and teaching assistant within one week after the homework assignment by email.

  Homework submitted *one week after the deadline* will be accepted but only accounts for 50% credit. No further late homework will be accepted.

- Academic report (to be assigned on ~7th week; 20%)
- Final presentation (present in English, per person or group; 30%)

C. Student Guide.

- Teaching Methods. Lecture notes and videos (that show the presentation of slides, derivation of the formula, and detailed instruction) can be downloaded from *course.pku.edu.cn* by students. These materials are used for self-study. Considering the inconvenient access to Internet for some students, NO online instruction/class will be provided.
- Software. Lecture notes are in form of .pdf and videos in .mp4. Software such as *Adobe Acrobat Reader* and *Windows Media Player* should be able to open these files.
- Lecture schedule. Lecture notes and videos will be uploaded usually one day before our class, i.e. Tuesday. Pay attention to the notices at *course.pku.edu.cn* if there is any change for the schedule.

D. Contact. Use the email of qlhe@pku.edu.cn to contact the instructor, Qing Lin He, for questions, discussion and appointment. Use the email of huiminsun@pku.edu.cn to contact the teaching assistant, Huimin Sun.

E. Reading materials. Some reading materials for extended learning will be uploaded to course.pku.edu.cn. These materials are for self-study and will not be discussed in the class.

Enjoy it!